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# CONSERVATION IN ALBERTA

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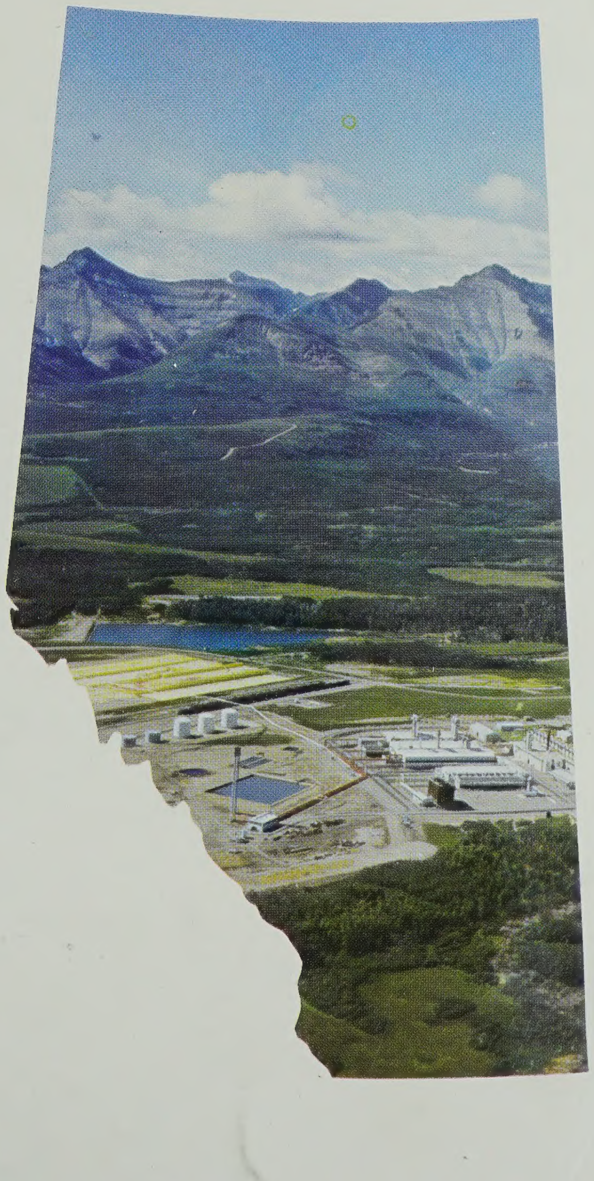
## 1966



OIL AND GAS CONSERVATION BOARD
603 SIXTH AVENUE SOUTH WEST - CALGARY, ALBERTA

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## TABLE OF CONTENTS

Page

The Need for Conservation .......................... 1
Responsibilities of the Board...................... 2
Production and Reserves............................ 3
Enhanced Recovery of Crude Oil..................... 6
Conservation of Solution Gas....................... 8
Sulphur Recovery from Sour Gas..................... 10
Production and Disposal of Salt Water.............. 11
Summary of Board Operations - 1966................. 14

# PREFACE

"Conservation in Alberta, 1966" has been prepared by the Oil and Gas Conservation Board to acquaint members of the Legislative Assembly of Alberta and the public at large with the conservation of Alberta's oil and gas resources and with the role of the Board. The text has been written in a non-technical style without detailed statistics.

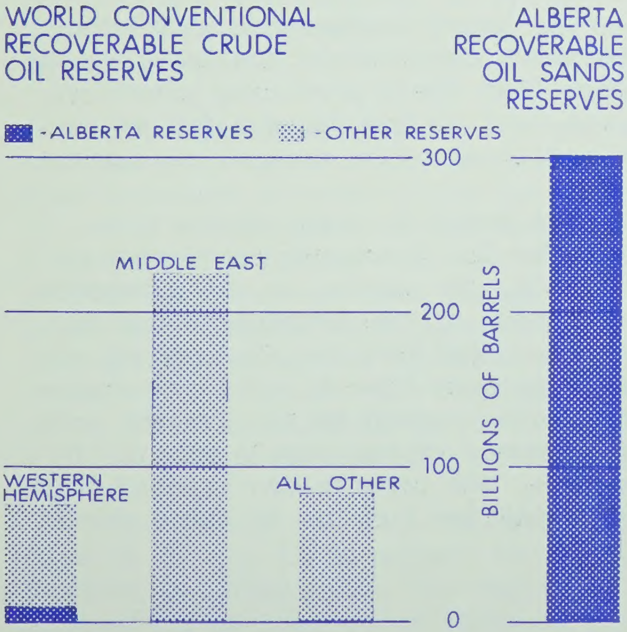
Included in the report are a discussion of the need for conservation, an outline of the responsibilities of the Board and a brief review of the reserves and production of oil and gas and their by-products. The enhanced recovery of crude oil and the conservation of solution gas are also discussed. This particular edition features two sections dealing with the recovery of sulphur from sour natural gas and the production and disposal of salt water. The final section in the report briefly summarizes Board operations during 1966.

The detailed publication "Report of the Operations of the Oil and Gas Conservation Board" is not being published for general distribution this year but is available on request.

# THE NEED FOR CONSERVATION

Today there is general acceptance of the need for conserving or effectively using our many natural resources. It is recognized that we have a responsibility not only to those living today but also to future generations to prevent the dissipation of these resources through careless, inefficient or wasteful practices.

During the last two decades, exploration has proved the existence of major reserves of oil and gas in Alberta. In addition, technological advances have made it possible to commercially develop the enormous reserves in the world famous Athabasca Oil Sands. Oil and gas resources, unlike forests and water, are "non-renewable" and so the overall supply is ultimately limited. Thus, with the potentially available reserves having to satisfy ever growing energy demands, conservation of oil and gas resources has become particularly important for the people of Alberta.



Oil and gas resources have unique properties, and the degree of success in recovering the underground reserves depends upon the production techniques employed. Oil and gas are fluid resources which are recovered by means of wells drilled to the underground reservoirs. If the natural reservoir energy, whether this be gas, water or both, is carefully guarded and utilized, recovery can be substantially increased. Furthermore, we have learned to supplement natural forces by the injection of fluids into the reservoir.

Although maximum recovery of oil and gas reserves can be achieved through the application of sound conservation practices, there are natural competitive factors that on occasion run counter to this concept. In most oil and gas pools, the reserves are owned by several parties. This, combined with the migratory nature of oil and gas, sometimes leads an owner to adopt practices that will provide immediate gain but not meet satisfactorily high conservation standards. Multiple ownership of an oil and gas pool also makes it necessary to ensure the protection of the rights of all owners in the pool, since the oil and gas reserves attributable to the lands of one owner may be "drained" and produced by wells drilled by another owner.

It is important to recognize that conservation must be considered not only in terms of physical recoveries but also in terms of the associated costs. Physical conservation that is unreasonably expensive to achieve is uneconomic and cannot be justified. The assessment of increased recoveries as opposed to the increased costs is a complex matter subject to varying interpretations.

A further aspect of conservation in the oil and gas industry is the impact that field production operations may have on other natural resources. Careless production practices may cause the contamination or destruction of soil, water supplies, forests and wild life.

Conservation is thus a complex matter which requires co-operation and understanding by all parties if it is to be resolved satisfactorily.

## RESPONSIBILITIES OF THE BOARD

The Oil and Gas Conservation Board was established by the Alberta Legislature in 1938. Its basic purpose, as set forth in The Oil and Gas Conservation Act, is to ensure the conservation of the Province's oil and gas resources. More particularly it is responsible for eliminating any practice which reduces the economically recoverable quantity of oil or gas, for ensuring safe and efficient drilling and production methods, and for providing an opportunity for each owner in an oil or gas pool to recover his fair share of the production from that pool.

To effectively discharge its responsibilities the Board must see that, in the light of sound engineering and economic principles, oil field operations are so conducted that wells are properly located, spaced, drilled, equipped and produced, so that the recovery of oil or gas from the pool is not lessened and reservoir energy is not improperly dissipated. The Board must also make certain that enhanced recovery techniques are used where suitable and that waste of gas is minimized.

In carrying out these functions, the Board, in co-operation with industry, has established specific regulations and policies. The Act provides the Board with authority to require operators to undertake operations necessary to improve conservation. The Board, through its staff, maintains a close surveillance of each producing oil and gas field to ensure that producing operations will provide maximum recovery.

Protection of the rights of owners in oil and gas pools is also provided for in the Act. An owner may apply to the Board for relief if he believes that he is being deprived of the opportunity to obtain his equitable share of production.

The Board co-operates with other Government departments and industry to ensure that field producing practices do not lead to the destruction or contamination of other natural resources.

The Board is also responsible under The Gas Resources Preservation Act, 1956, for seeing to the effective utilization of the Province's gas resources. Applications for removal of gas or propane from Alberta are evaluated having regard to the present and future needs of the people within the Province, and permits are granted only for quantities surplus to these needs.

## PRODUCTION AND RESERVES

### CRUDE OIL

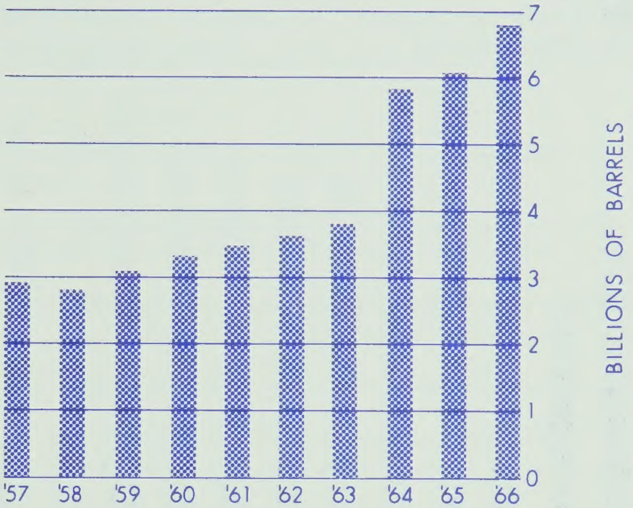
According to Board estimates, Alberta's remaining recoverable reserves of crude oil have more than doubled during the last decade. At the end of 1966, they amounted to 6.8 billion barrels. A significant change in reserve outlook occurred after 1963, with three-quarters of the ten-year growth taking place during these last three years. Successful exploration and the institution of enhanced recovery schemes have been primarily responsible for this substantial growth, although the reappraisal of previous reserve estimates also had an impact.

In 1964 and 1965, the Gilwood sand discoveries in the Lesser Slave Lake region added substantially to the Province's reserves. In 1965 and 1966, the spectacular discoveries at Rainbow Lake and Zama Lake in the far northwestern corner of the Province had a considerable effect on the reserve picture and are expected to provide further significant increases in the next few years.

Through the institution of enhanced recovery operations, the industry has increased substantially the volumes of crude oil expected to be recovered from existing fields. In the three years, 1964 through 1966, large reserve increases were recognized through the extension of flood operations in Pembina and the initiation of water flood operations in virtually all oil fields in the Swan Hills area.

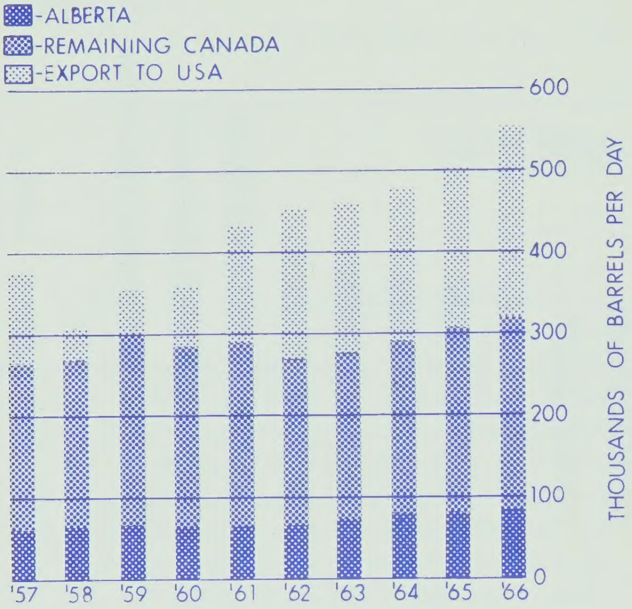
The demand for Alberta crude oil depends on the total market for Western Canadian crude oil and the proportion of that market that is supplied by other western provinces.

ALBERTA REMAINING CRUDE OIL RESERVES



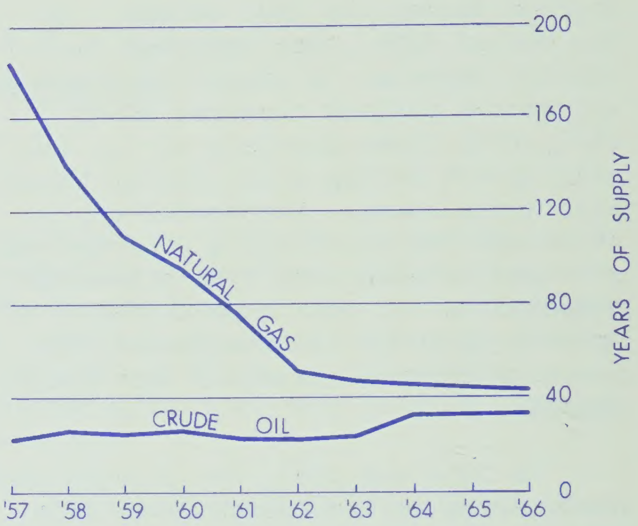
During the last ten years, total demand has increased by 380 thousand barrels per day but Alberta's share of it has increased by only 180 thousand barrels per day. This lower increase results from the substantial growth in production from Saskatchewan.

The marketing pattern of Alberta production has not changed significantly since 1960, with the exception of the marked increase in exports to the United States in 1966. Today, approximately 15 per cent of Alberta's production is needed to meet local requirements, with the remainder being evenly divided between Canadian and American markets.



ALBERTA CRUDE OIL DELIVERIES

An assessment of the significance of remaining crude oil reserves can be made by calculating "years of supply". This figure is determined by dividing remaining crude oil reserves by current annual production rates. Thus, in 1966, Alberta reserves were sufficient to meet the 1966 rate of production for a 33-year period. This compares to approximately 22 years in 1957. The increase in the years of supply outlook that occurred in 1964 relates to the substantial reserve increase at that time. Corresponding years of supply for Canada and the United States are 25 years and 12 years, respectively.

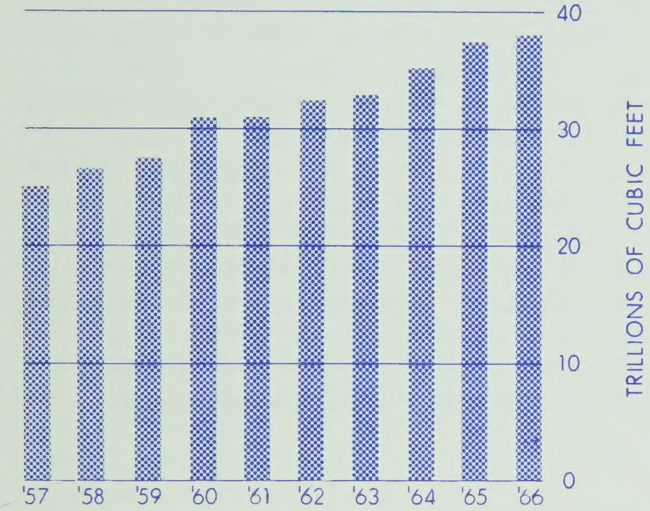


YEARS OF SUPPLY OF ALBERTA CRUDE OIL AND NATURAL GAS

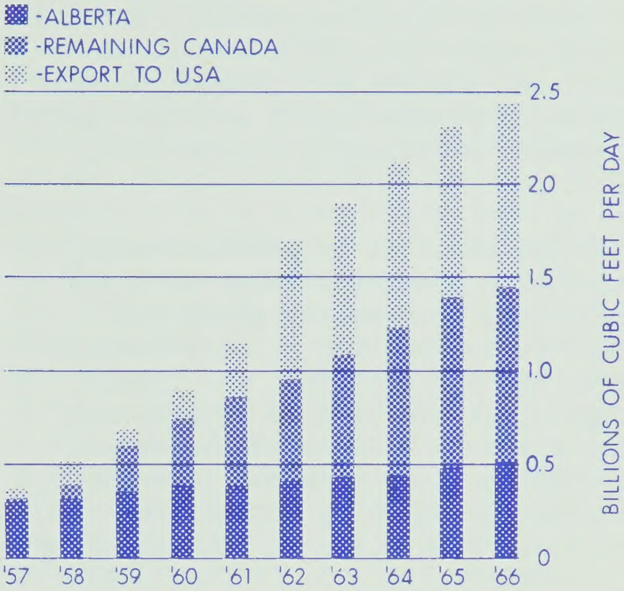
## NATURAL GAS

Growth in remaining reserves of natural gas during the last ten years has been somewhat erratic. In recent years, particularly in 1965 and 1966, there have been only very small increases in remaining reserves. The Board believes that this is primarily due to the concentration of exploration activity in the Rainbow oil play in north-western Alberta and the dependence of reserve development in new fields on market conditions. Remaining reserves of gas at the end of 1966 were estimated by the Board to be 38 trillion cubic feet or 13 trillion cubic feet greater than in 1957.

ALBERTA REMAINING NATURAL GAS RESERVES



ALBERTA NATURAL GAS DELIVERIES



Production of gas during the last ten years has increased very substantially and in 1966 was approximately five times greater than in 1957. This increase was attributable almost exclusively to the large volumes being removed from the Province through the major gas transmission lines serving the other prairie provinces and eastern Canada and exporting gas to the United States.

In 1957, most of the gas produced in Alberta was consumed in the Province. By 1966, this situation had changed considerably, and Alberta requirements represented only 20 per cent of total production, while the remaining production was divided evenly between Canadian and American markets.

As with oil, the remaining reserves of gas may be assessed in terms of the number of years that they will supply the current market requirements. In 1966, the Board's estimate of remaining reserves indicated a 43-year supply life. This can be compared to the 184 years which applied in 1957. The very substantial difference is explained by the acquisition of the new markets referred to previously. The current level for Alberta of 43 years of supply can be compared to 39 years for Canada and 17 years for the United States.

## NATURAL GAS LIQUIDS

Natural gas liquids, that is pentanes plus, propane and butanes, are produced in association with crude oil and gas. The production of each has expanded rapidly, particularly since 1961, as a result of increased natural gas production and increased processing of solution gas produced in conjunction with crude oil.

The reserves of pentanes plus, which is a product similar to light crude oil, were estimated by the Board to be some 600 million barrels as at the end of 1966. The first comprehensive estimates of pentanes plus reserves made by the Board was in 1960 at which time the reserves were estimated to be 400 million barrels. Production in 1957 was five thousand barrels per day and by 1966 this had increased to 77 thousand barrels per day. At this latter level, it is equivalent to 14 per cent of crude oil production. The years of supply of the 1966 reserves is 22 years.

Reserves of propane and butanes as at December, 1966 were estimated to be 385 and 256 million barrels respectively. Since 1961, production of these two products has more than quadrupled. Production of propane and butanes was initially absorbed by expanding Canadian markets but during the last year substantial exports of both products have been made to the United States. In addition, propane has been exported to Japan commencing in 1966. The years of supply based on 1966 reserves and production is about 33 years.

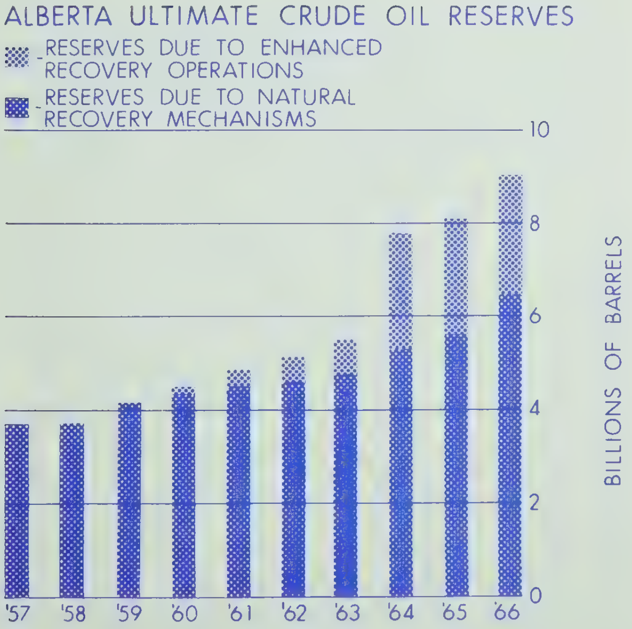
## ENHANCED RECOVERY OF CRUDE OIL

Recovery of oil from a pool by natural reservoir energy may vary considerably. In pools where the oil is contained in porous rock which has poorly connected flow channels or where the reservoir energy is low, recovery of oil by natural means is generally in the range of 5 to 20 per cent of the oil in place. However, in pools having good flow channels and other favourable characteristics, the natural energy forces of expansion will be efficiently utilized and recovery by natural means may range up to 70 per cent. In pools with mixed characteristics and various combinations of natural producing energies, recoveries vary over a wide range.

In many pools, the recovery of oil may be enhanced considerably by the injection of fluids into the producing zone to maintain reservoir pressure. Several types of enhanced recovery methods have been developed. The most widely used is that involving the injection of water, although injection of gas and of solvents are also used. Generally, pressure maintenance by fluid injection may double or triple the recovery of crude oil from a pool having a relatively low recovery by natural means. For pools with more efficient natural drives, the increase may be quite substantial in terms of barrels of oil, but not as impressive when expressed as a percentage increase.

The increase of oil recovery by fluid injection first became significant in Alberta in 1955 with the commencement of water injection in part of the Leduc-Woodbend Field. Prior to 1953, most important oil discoveries were in reef-type reservoirs with strong natural water drives and consequent high natural recoveries. Since then, the discovery and development of such areas as Pembina and Swan Hills with their relatively inefficient natural recoveries has led to the extensive use of enhanced recovery methods.

The increase in recoverable crude oil reserves attributable to enhanced recovery methods was some 2.5 billion barrels as at the end of 1966. Or looking at this matter from another point of view, the Province-wide percentage recovery of oil in place has been increased from 23 per cent to 32 per cent.



Since 1958, enhanced recovery schemes have been instituted in many Alberta oil fields. Today, 70 per cent of the major oil pools in the Province are subject to some method of enhanced recovery. Two of the more spectacular operations are the solvent injection scheme in the Golden Spike Field and a multitude of water, gas and solvent injection schemes in the Pembina Field. The Golden Spike operation was instituted in order to increase the recovery from the very high natural rate of some 70 per cent to an exceptional figure of over 90 per cent. In the areally-large Pembina Field, of the 3,000 wells producing from the Cardium formation, a very large percentage are affected by enhanced recovery operations. In total, there are more than 1,100 wells injecting water, gas or solvent into the reservoir. The overall average recovery in the portion of the Pembina Cardium Pool subject to enhanced recovery has been increased from 12 per cent to 26 per cent, which constitutes an increase in reserves of some 850 million barrels.

Alberta has large known reserves of heavy crude oil. Some reservoirs cannot be produced at all by natural recovery methods, while in others only a very low recovery is achieved. In recent years, experimental operations have been conducted to determine the best means of enhancing recovery in these heavy oil pools.

The Board's role in enhanced recovery of crude oil is twofold. The Board staff regularly review all significant pools producing by natural recovery methods to determine whether it would be feasible to employ fluid injection operations to increase the recovery of crude oil. Should it be decided that enhanced recovery methods are desirable, the Board encourages the operators to implement them and has the authority to require such operations where necessary in the interests of conservation. It is worth noting that production rates in Alberta are proportional to the oil recoverable from the pool. Consequently, there is an incentive for the operator to implement such operations.

Before enhanced recovery operations may be instituted, the Board is required to review and approve all such proposals. In making this assessment, the Board is concerned with the adequacy of the scheme, the impact on other owners and the overall question of whether maximum recovery will be achieved.

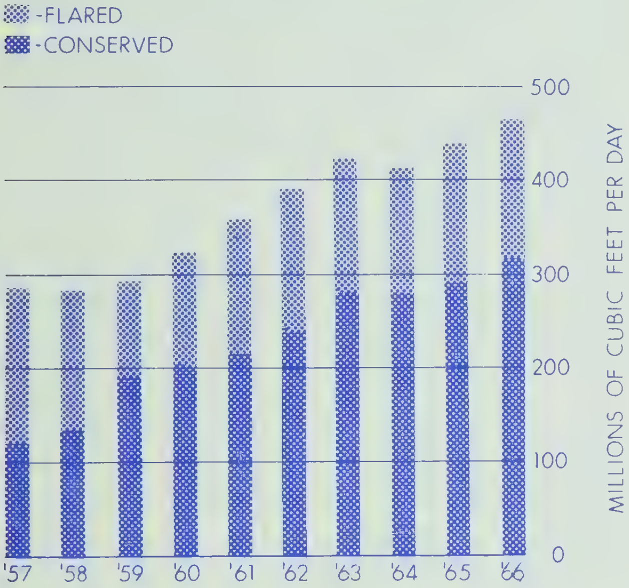
## CONSERVATION OF SOLUTION GAS

Of Alberta's 39 trillion cubic feet of marketable gas reserves, 3.3 trillion cubic feet are reserves of solution gas which are produced unavoidably with crude oil. The remaining 36 trillion cubic feet of non-solution gas are produced only to meet gas market requirements and consequently do not present a significant conservation problem. Only small volumes, approximately one per cent, of such gas are flared during emergencies caused by operational problems in the gathering or processing of the gas.

On the other hand, the conservation of solution gas is a difficult problem. Solution gas produced in conjunction with crude oil must be separated from the oil before the oil is marketable. Separation is normally completed at field production batteries. Having separated the gas, the operator must either deliver it into a gas gathering system, inject it in a reservoir or burn it. From a broad conservation viewpoint, the latter alternative is unacceptable but there are circumstances where unfortunately it is the only practical solution.

In a newly discovered oil pool where the extent of the oil reserves is unknown and where there are no available facilities for either the gathering and processing of the gas or for its underground storage, there is little alternative left but to flare the gas, at least temporarily. As further exploration and development of the area provide more information, it becomes possible to determine whether conservation or underground storage can be economically justified. There are a number of fields where the volumes are too small or the costs of conserving the gas too great, and the gas continues to be flared. Many schemes for the conservation of solution gas have been instituted in the Province as is indicated by the significant reserves that are presently expected to be recovered by this means. In 1966, approximately 70 per cent of the solution gas produced in the Province was conserved. This compares with just over 40 per cent in 1957. The latter percentage is quite low and reflects the flaring of large volumes of gas produced in the Pembina

Field prior to the completion of gathering and processing facilities. By 1959, this system had become operative and the percentage of solution gas conserved increased to 65 per cent, only to again decline temporarily due to the rapid development of the Swan Hills Area.


ALBERTA SOLUTION GAS PRODUCTION

Of the solution gas conserved in 1966, two-thirds was gathered and processed for sale as marketable gas and liquid products and one-third was injected into reservoirs either for storage or for crude oil recovery enhancement operations.

There are several major solution gas conservation schemes operating in the Province. For example, the Judy Creek plant in the Swan Hills area processes all of the gas produced from several oil fields in this area and delivers the dry residue gas to Northwestern Utilities, Limited for its requirements in the Edmonton area. A similar type of operation exists in the Pembina Field and again the residue gas is delivered to Northwestern Utilities. In fact, Northwestern obtains approximately 55 per cent of its total gas supply from conserved solution gas. For the province as a whole, approximately 35 per cent of the annual requirements are supplied by solution gas.

Conservation of solution gas also permits the recovery of natural gas liquids. Substantial production and reserves of propane, butanes and pentanes plus have been provided by this means.

The Board is responsible for ensuring that solution gas is not wasted wherever it can be economically conserved. The Board staff regularly reviews all producing oil pools in which the solution gas produced is not conserved in order to determine whether such conservation appears to be feasible. Where it does appear to be feasible, the Board meets with operators to encourage them to undertake operations for the gathering of the solution gas and has the authority to restrict or prohibit the production of oil should such operations not be undertaken.

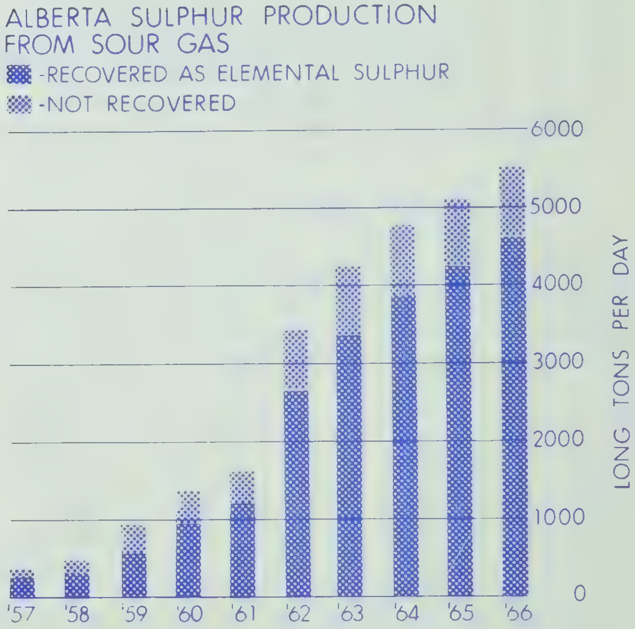
## SULPHUR RECOVERY FROM SOUR GAS

In Alberta, sulphur frequently occurs as a component of natural gas in the form of hydrogen sulphide, a highly toxic, noxious gas. The concentration of hydrogen sulphide in gas varies from very low values in most fields in the plains area of eastern Alberta to values of over 30 per cent in the western foothills. Hydrogen sulphide must be removed before the gas can be marketed. When the hydrogen sulphide concentration is very low, its extraction from the gas stream is simply a cost associated with producing marketable gas. When the concentrations are higher or the volume of gas being processed is very large, the extraction of elemental sulphur becomes a substantial revenue-producing operation in itself.

Regardless of whether there is a sufficient concentration of hydrogen sulphide to warrant construction of sulphur extraction facilities, whenever an oil or gas pool contains significant concentrations of hydrogen sulphide there is a potential air pollution problem. Responsibility for the control of pollution rests with the Provincial Department of Health. The Board and the Department co-operate to ensure that the sour gas that cannot be recovered as sulphur is converted to sulphur dioxide by burning in properly designed stacks to limit ground concentrations of sulphur dioxide to acceptable standards.

During recent years, there has been a dramatic rise in the production of sulphur in Alberta. In ten years, the recovery has grown from 250 long tons of sulphur per day to 4,600 long tons in 1966. Two factors have led to this substantial growth. The increase in sales of Alberta gas, primarily in Eastern Canada and the United States, has resulted in more sulphur extraction plants being built to process the further volumes of gas required to meet gas market commitments. In addition, this expanded production has coincided with a time of rapid increase in the world demand for sulphur to meet requirements of industrial growth.

The strong market demand has been reflected in rising sulphur prices which enhance the economic incentive for the recovery of additional quantities of sulphur.


ALBERTA SULPHUR PRODUCTION FROM SOUR GAS

The majority of marketed sulphur is used in the manufacture of sulphuric acid, which in turn is a basic industrial raw material, particularly in the chemical, fertilizer, pulp and paper, and metal industries.

In Alberta, the construction of new sulphur recovery facilities has been announced for plants at Crossfield, Bigstone and Rainbow. Furthermore, the completion in 1967 of the Great Canadian Oil Sands synthetic crude oil plant in the Athabasca Oil Sands will add significantly to sulphur production.

Another interesting feature in the marketing of sulphur was the recent announcement of plans to construct a solids pipe line which would transport sulphur in slurry form from producing plants in Alberta to the West Coast.

Over the past three years, the proportion of Alberta sulphur production consumed within the Province has risen primarily due to the expansion of the fertilizer industry. Deliveries to the United States have also increased significantly. These trends have been associated with a decline in the proportion of offshore sales. In 1964, offshore markets absorbed the greatest share of Alberta production but by 1966 this position had been assumed by the United States.

The Board estimates the Alberta reserves of sulphur at the end of 1966 to be 110 million long tons, exclusive of that to be recovered from oil sands. Relating this to the 1966 rate of production indicates 65 years of supply.

## PRODUCTION AND DISPOSAL OF SALT WATER

### RESERVOIR WATER, AN ASSET AND A LIABILITY

The presence of salt water underlying hydrocarbons in an oil reservoir frequently ensures a relatively high rate of recovery without the need and expense of employing enhanced recovery operations. In addition to improving recovery, the water drive may eliminate the necessity of installing expensive pumping equipment to "lift" the oil to the surface. Many of Alberta's oil pools benefit from the presence of an active water drive.

Unfortunately, in a water drive reservoir, water is produced with the oil and gas and creates problems of separation and disposal when the liquid mixture reaches the surface.

The water must be separated before the oil and gas can be marketed. In general, water is separated from oil by the application of heat and chemicals, and from gas by the use of liquid or solid drying agents.

The disposal of the separated water presents a second problem. While marketing requirements act as an incentive for the separation of water, there are lesser incentives to encourage its proper disposal. In fact the costs associated with satisfactory disposal are a deterrent. Nevertheless, industry and government recognize that the satisfactory disposal of salt water is of prime importance and must be effective if soil and water contamination are to be avoided.

## NATURE OF PRODUCED WATER

The salinity of the brine produced with hydrocarbons ranges from 5,000 to 300,000 parts per million. As a rule, salinity increases with the age or depth of the source formation, but salinities in the same formation vary substantially across the Province. In addition to salts, small amounts of soluble hydrocarbons and sulphur compounds are present which contaminate water and are often poisonous to fish and animals even when their concentrations are as low as one part per million. The importance of keeping oil field brine from polluting fresh water supplies and soil is evident.

## METHODS OF DISPOSAL

Disposal methods fall into two categories - surface and subsurface. The Board and industry concur in the view that in general the former is unsatisfactory.

Surface disposal is simply the storage of water in open pits. Seepage into the subsoil and evaporation, either natural or aided by heat from burning gas, prevent the pits from overflowing.

Subsurface disposal involves the return of the produced water to either the zone of origin or some other zone. Its chief advantage is the ability to handle large volumes of water, while completely eliminating contamination problems. The disadvantage of subsurface disposal is the expense involved in that it requires a well and frequently a high pressure pump to inject the water into the formation. In cases where a non-productive well is available for conversion to a disposal well and the reservoir pressure is low enough that the water will flow by gravity into the reservoir, subsurface disposal of produced water is substantially less expensive.

## BOARD DISPOSAL REQUIREMENTS

The Board recognizes that, while subsurface disposal is the only long-term satisfactory method, it may not be practical when the volumes of produced water are very small or during the initial field development period. Where surface disposal of produced water is permitted, the water is stored in an earthen pit constructed to certain minimum standards. Water disposal pits must be excavated and diked to ensure that they will not be washed out by run-off water. They are lined with clay to keep seepage to a minimum, and are of limited size to prevent unnecessary waste of land. These pits are restricted by the Board to one per production installation and the volume of water that can be disposed is limited to a maximum of 600 barrels per month per pit.

Where the operators have had a reasonable period in which to develop a subsurface disposal scheme or where there is danger of contaminating water supplies or agricultural land, the Board reduces the amount of surface disposal permitted. This usually occurs in two steps; first to 300 barrels per month per pit for about a one-year period, then to 100 barrels per month per pit for the balance of the life of the wells in the field. The Board does not wait until water pollution or soil damage occurs before restricting surface disposal.

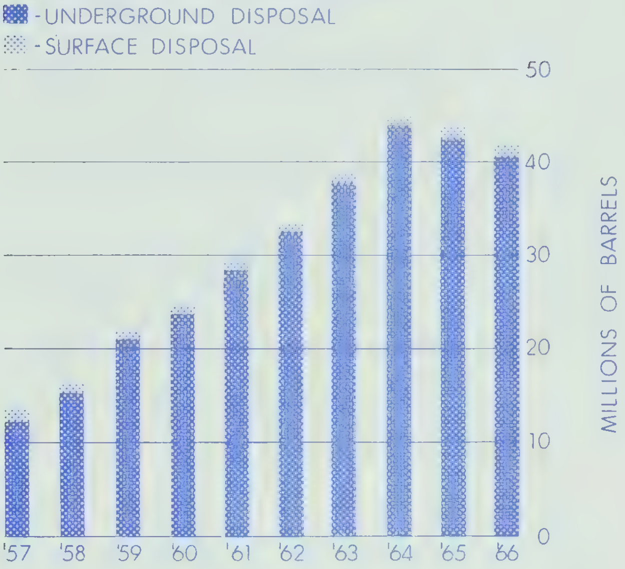
Before approving a subsurface disposal scheme, the Board ensures that each disposal well is completed in such a manner that damage will not occur to either the hydrocarbon reservoir or any fresh water zone in the well.

## EFFECT OF BOARD POLICY

Prior to 1951, virtually all water produced in Alberta with oil and gas production was disposed to surface pits. In the intervening years, the water produced with gas and oil has increased from 1 million to 42 million barrels per year, yet the volume disposed to surface pits has not increased. Considering that there are approximately 1,800 batteries in the Province, the average pit disposal per battery would be less than 65 barrels per month.

All fields in which significant volumes of water are produced have subsurface disposal schemes and, in areas where limited surface disposal is necessary, periodic checks are made by the Board field staff to ensure that the water is properly contained.

Because of the co-operation of the oil and gas industry in adhering to the water disposal requirements established by the Board, water pollution and land damage due to the improper disposal of oil field brine is insignificant in Alberta.


ALBERTA SALT WATER PRODUCTION AND DISPOSAL

# SUMMARY OF BOARD OPERATIONS - 1966

## ORGANIZATION AND STAFF

The three Board Members, appointed by the Lieutenant Governor in Council are G. W. Govier, P. Eng., Chairman, A. F. Manyluk, P. Eng., Deputy Chairman, and Vernon Millard, Member.

The Board has a staff of 260 with approximately 50 engineers and geologists. About 200 staff members are located in the Calgary head office, with the balance employed at the Core Storage Center, Edmonton Chemical Laboratory and five Area Offices.

The Board's senior advisers are its Chief Engineer and Solicitor. They provide technical and legal advice directly to the Board and, where appointed for the purpose, function as Acting Board Members. An Applications Advisory Group, under the Chairmanship of the Chief Engineer and including the Board Solicitor and the Managers of the Gas, Oil and Development Departments, advises the Board on routine applications.

In addition to normal departmental responsibilities, the Managers of the engineering departments serve with other senior staff as Examiners at public hearings.

The Oil and Gas Departments are primarily concerned with the maximum efficient recovery of oil and gas and related problems. The Development Department, with its Drilling, Production and Field Divisions, is responsible for the standards and inspection of the methods, technology and equipment used in drilling and producing wells. Engineers and technicians in area offices located in Black Diamond, Drayton Valley, Edmonton, Medicine Hat and Red Deer inspect and report on industry operations in the field. A Chemical Laboratory, situated in Edmonton at the University of Alberta, adds to the Board's technical facilities.

The Geological Department's chief function is to provide geological interpretation of oil and gas reservoirs. It also includes a Core Storage Center located in Calgary in which samples of drill cuttings and cores recovered in drilling wells are stored. The Center includes facilities for the examination of samples and cores by industry and the general public.

The Data Processing Department is responsible for computer programming and applications. The leasing of I.B.M. System 360 Computer equipment provides for a fully integrated, organization-wide data storage, retrieval and processing system.

A list of the managers of all Board Departments is provided on the back page of this report.

## IMPORTANT BOARD ACTIVITIES IN 1966

During the year, the Board and its staff made special efforts to increase the conservation of solution gas. The staff made careful technical and economic analyses of all instances where significant volumes of gas were being flared. Where improvement appeared to be feasible, the Board met with the operators involved, considered means of increasing conservation, and, where necessary, issued orders requiring that solution gas be gathered or that existing systems be expanded. While much was accomplished through this process, several areas continued to cause the Board concern at year-end.

The assessment of oil pools in which enhanced recovery schemes might be initiated was continued during 1966. Several such pools were identified and meetings were held with the appropriate operators to consider full fledged studies. In some cases this led to the implementation of enhanced recovery schemes, while in others the question has not been resolved.

The Board considered four major applications for the removal of gas or propane from the Province. The two major gas purchase companies, Trans-Canada Pipe Lines Limited and Alberta and Southern Gas Co. Ltd., applied for increased volumes which totalled some 4.6 trillion cubic feet. Of the two applications to remove propane from the Province, the most important was that involving the export of relatively large volumes to Japan. In all four applications, the Board, after careful consideration of available reserves and long term provincial requirements, and with the approval of the Lieutenant Governor in Council granted the applications.

Progress in conversion of computer facilities to the I.B.M. System 360 was highlighted by delivery of the new equipment in November. Training and preparation of the I.B.M. system, which started in 1965, was largely completed in 1966. A temporary work section was formed to transcribe well information for automatic computer retrieval.

To increase the efficiency of field operations, area offices at Devon, Redwater and Camrose were closed and a new consolidated office opened in Edmonton. Field work has been reduced by changes in production methods which have decreased the number of wells actually used for production purposes and by the industry's move toward more automation and larger centralized facilities. These changes and the recent discoveries in Northern Alberta made Edmonton the logical site for a central area office.

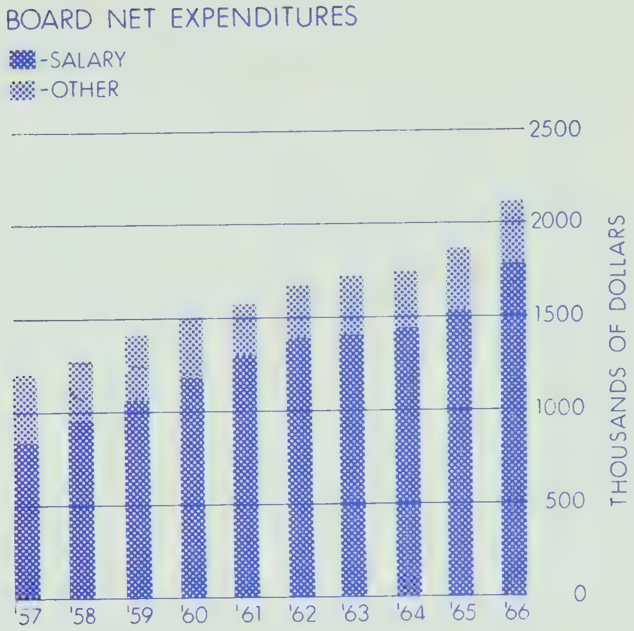
## EXPENDITURES AND REVENUES

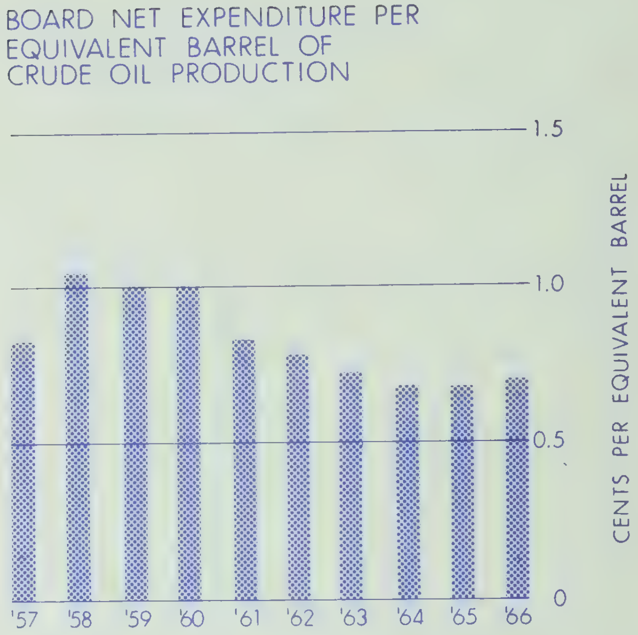
The Board obtains funds, for the defrayment of its expenditures, by a direct grant from the Provincial Government and by levying a tax on oil and gas properties in the Province. Since most of the mineral rights in Alberta are owned by the Crown and leased to industry, the Government is also a tax payer. In total, the Government provides approximately fifty per cent of the Board's net expenditure with the remaining share being obtained from other owners of oil and gas properties - mainly the oil and gas industry.

In 1966, net expenditures were 2.1 million dollars, an increase of approximately 13 per cent over the previous year. This increase was due primarily to increasing salary costs and to the cost of converting to the new computer system.

Salaries constitute 84 per cent of the Board's net expenditure. The remaining portion is accounted for by various operating expenses and the cost of acquiring capital equipment. Income derived from the sale of publications, maps and services, together with a portion of the drilling licence fee, help defray some expenditures. Such income amounted to $200,000 in 1966.

The cost of the Board operations may be evaluated by reducing net expenditures to the number of cents per equivalent barrel* of crude oil production. During the last ten years, this cost varied between two-thirds of a cent and one cent, with a decreasing trend since 1958. In 1966, the cost was approximately two-thirds of a cent per equivalent barrel.





* Equivalent Barrel = $\frac{\text{Total industry production revenue}}{\text{Weighted average price per barrel of oil}}$

## BOARD MEMBERS

| | |
|---|---|
| G. W. Govier | Chairman |
| A. F. Manyluk | Deputy Chairman |
| Vernon Millard | Member |

## SENIOR ADVISORS

| | |
|---|---|
| D. R. Craig | Chief Engineer |
| N. A. Macleod | Solicitor |

## DEPARTMENT HEADS

| | |
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| V. E. Bohme | Development |
| N. J. Lashuk | Gas |
| N. A. Strom | Oil |
| G. J. DeSorcy | Data Processing |
| J. R. Pow | Geology |
| K. W. Fuller | Accounting |
| G. C. Watkins | Economic Studies |
| J. G. Anderson | Office Services |
| R. C. J. Webber | Personnel |